Forum: Security Council

Issue: Equitable Access to Safe Water as a Human Right

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Introduction

Water is crucial to the human society. It has been taking a significant role, it is taking a significant role, and it will. The importance of water is not only at its domestic use, but also at its agricultural and industrial use.

However, in some part of the world, there are millions, billions of people who lack secured access to static source of potable water, resulting in shortened life span, frequent water-borne epidemics, and so on. In order to accelerate the successful achievement of United Nations Sustainable Development Goal 6, equitable access to potable water is introduced as a human right to be guaranteed universally.

Definition of Key Terms

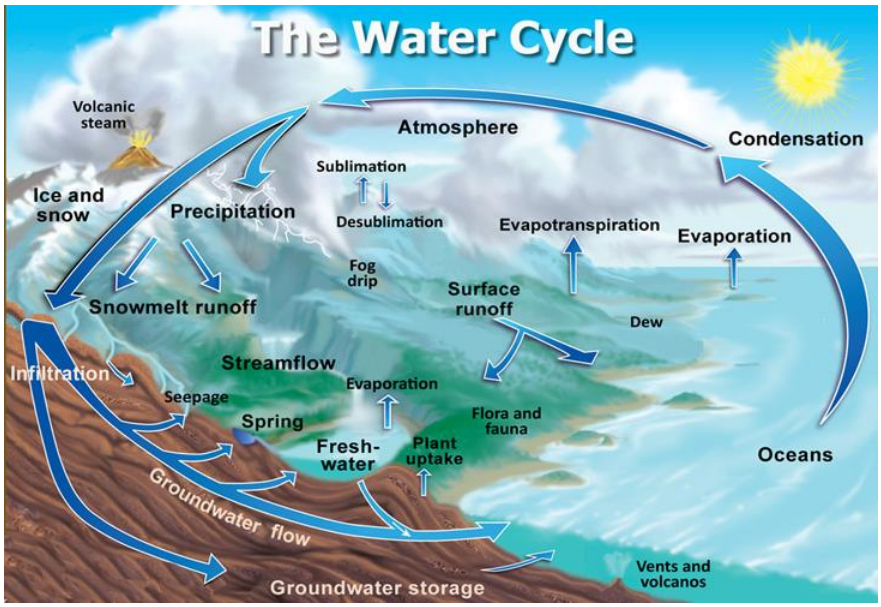
Key Concept	Definition and Explanation
Sufficient	According to the World Health Organization (WHO), between 50 and 100 liters of water per person per day are needed to ensure that most basic needs are met and few health concerns arise. There should not be any lack of water supply for each person's domestic use, include drinking, personal sanitation, washing of clothes, food preparation, household hygiene, to be called 'sufficient'.
Potable Water	The water required for each personal or domestic use must be safe, therefore free from micro-organisms, chemical substances and radiological hazards that constitute a threat to a person's health. Measures of drinking-water safety are usually defined by national and/or local standards for drinking-water quality. The World Health Organization (WHO) Guidelines for potable water quality provide a basis for the development of national standards that, if properly implemented, will ensure the safety of drinking-water.
Acceptable Quality of Water	Water should be of an acceptable color, odor and taste for domestic use.
Physically	United Nations claims that it's a human right to have a water and sanitation service that is physically accessible within, or in the immediate vicinity of the

Accessible	household, educational institution, workplace or health institution. According to WHO, the water source has to be within 1,000 meters of the home and collection time should not exceed 30 minutes.
Affordable	The United Nations Development Programme (UNDP) suggests that water costs should not exceed 3% of household income.
Sanitation	According to WHO, Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and feces. The word 'sanitation' also refers to the maintenance of hygienic conditions, through services such as garbage collection and wastewater disposal.
Hydrosphere	The system of water present in, on the surface of, and above the surface of the earth.
LIC	Stands for Low-Income Country. Country with GDP per Capita less than 1025USD, according to World Bank report of 2014.
HIC	Stands for High-Income Country. Country with GDP per Capita more than 12475USD, according to World Bank report of 2014.
Desalination	Process taking away mineral components from saline water. This turns saline water into desalinated, often potable, water.

Background Information: How's everybody's water?

Hydrological Cycle

The hydrological cycle (also known as water cycle), describes the continuous movement of water on, above and below the surface of the earth. The cycle involves a lot of processes such as but not limited to: precipitation, interception, surface run-off, infiltration, and percolation. Figure on the next page detailedly describes the hydrological cycle.

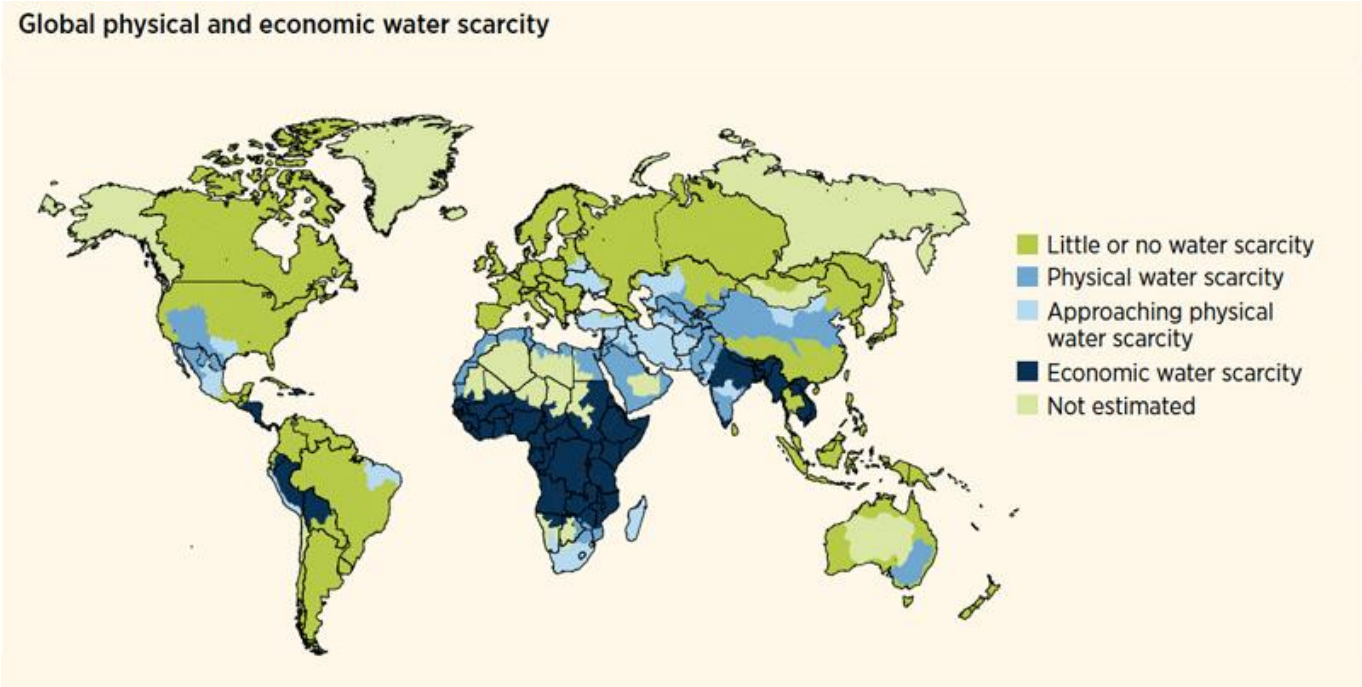


Classification of Water Scarcity and Its Global Trend

The level of water scarcity in a country depends on precipitation and water availability, population growth, demand for water, affordability of supplies, level of infrastructure, and so on. Where water supplies are inadequate, there are two types of water scarcity which could exist:

- Physical water scarcity:
  This is where water consumption exceeds 60 per cent of the useable supply. To help meet water needs some countries such as Saudi Arabia and Kuwait have to import much of their food and invest in desalinization plants.
- Economic water scarcity:
  This is where a country physically has sufficient water to meet its needs, but requires additional storage and transport facilities. This means having to embark on large and expensive water-development projects, as in many dry or steppe countries.

The following map from UN identifies global water scarcity trend.



Most of the nations suffering from the economic water scarcity are LICs located on Sub-Sahara region of Africa, whereas physical water scarcity appears to be commonly present in desert areas despite the nations' wealth.

Quantity of Water

Quantity of water depends on several factors in the hydrospheric cycle, which include:

- Rate of precipitation
- Evaporation
- Cell transpiration rate of local plants present
- River and groundwater flows

The world's available freshwater supply is not distributed evenly around the globe, either seasonally or for more than one year. About 75% of annual rainfall occurs in areas containing less than 33% of the global population. 67% of the global populations live in the areas receiving only a quarter of the world's annual rainfall.

Quality of Water

Water also needs to be of an adequate quality for consumption. In developing countries, however, too many people lack access to safe and affordable water supplies and sanitation. World Health Organization (WHO) estimates that 4000000 deaths each year respectively are from water-borne epidemics, particularly cholera, hepatitis, malaria and other parasitic diseases.

Water quality may be affected by organic waste from sewage, fertilizers and pesticides from agriculture, and by heavy metals and acids from industrial processes.

Potable Water Accessibility

Factors affecting access to potable water include:

- Water availability
- Water grid infrastructure
- Cost of water

Globally, urban areas are better served than rural areas, and countries in Asia, South America and the Caribbean are better off than African countries. For example, in case of Asia, China and India alone were made up of some 2.28 billion people.

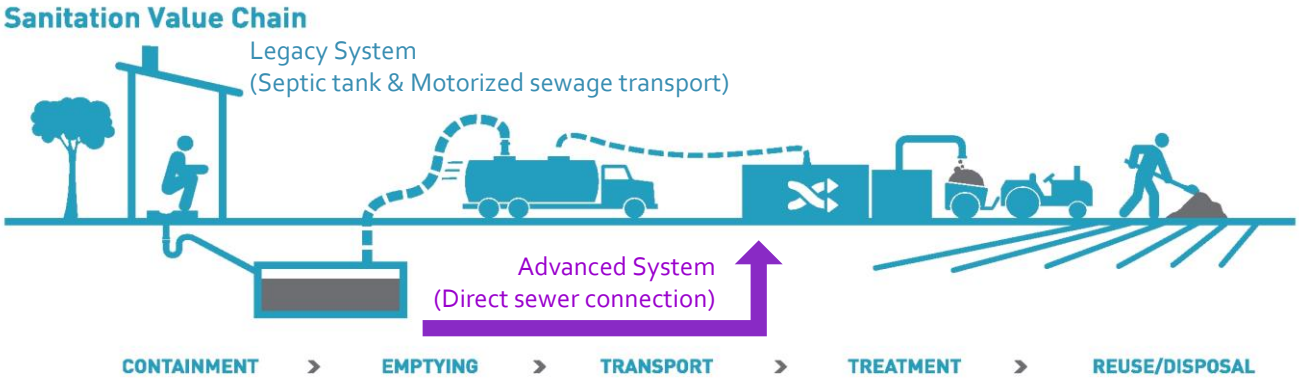
Many tap water systems, however, do not meet water quality criteria set by either World Health Organization or the country's government. This has caused a tendency to rely on bottled water for domestic uses to appear among more people, especially those who are easily accessible to nearby supermarkets.

Economic Ability and Access to Potable Water

In some cases, the poor actually pay more for their water than the rich. For instance, in Port-au-Prince, Haiti, surveys have proved that households connected to the tap water system typically paid around 1USD per m^3, while unconnected populations forced to purchase water from mobile vendors paid from 5.50USD to a staggering 16.50USD per the exact same amount of water, $1m^3$.

Modern Sanitation System and Its Effects

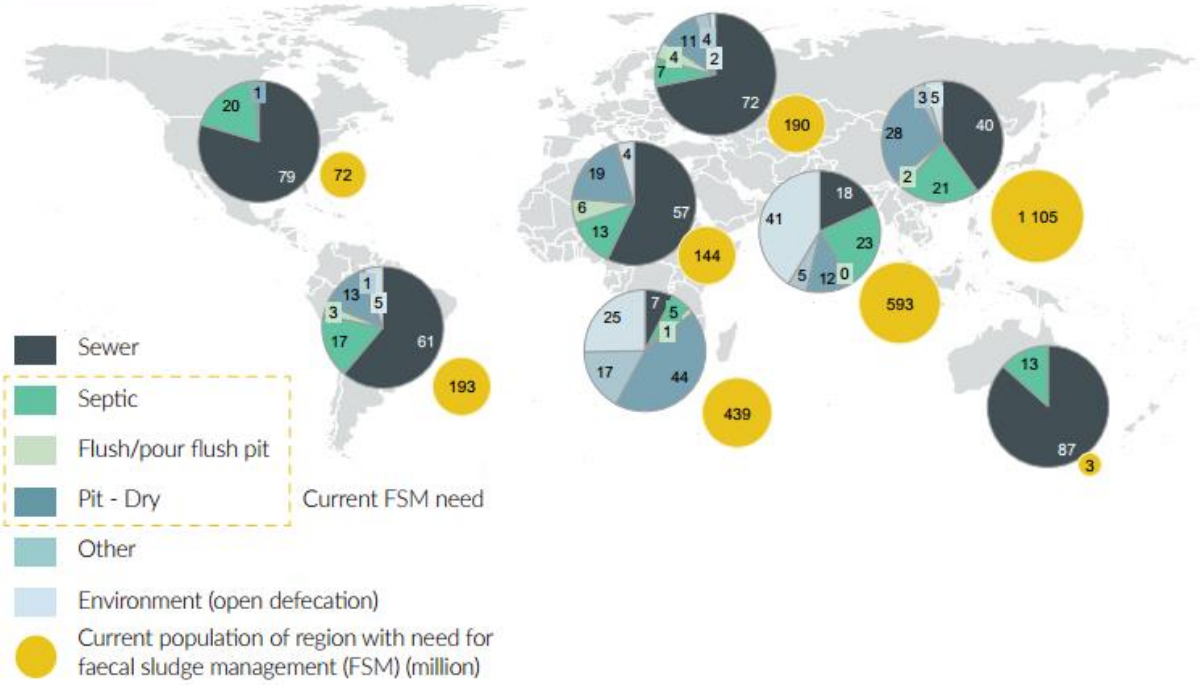
According to WHO, Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and feces. The word 'sanitation' also refers to the maintenance of hygienic conditions, through services such as garbage collection and wastewater disposal.



Above figure is showing an example of simple sanitation system with a few legacy systems, such as septic tank and motorized sewage transport involved in the chain. More advanced modern systems might include direct sanitary sewer connection to the water treatment plant.

At the final stage of the sanitation systems (sewage treatment plants), the sewage is biologically treated by **Active Sludge Process**, which utilizes aerobic micro-organisms that can digest organic matter in sewage. This process is extremely effective, flexible, and economic, about 95% of the sewage treatment plants present in the world employed.

Figure 5.1 Percentage of population served by different types of sanitation systems



Source: Cairns-Smith et al. (2014, Fig. 8, p. 25, based on data from WHO/UNICEF JMP). Courtesy of the Boston Consulting Group.

According to the data from WHO/UNICEF JMP (Joint Monitoring Programme), in 2015, 2.3 billion people still do not have basic sanitation facilities such as toilets or latrines. Of these, 892 million still defecate in the open, for example in street gutters, behind bushes or into open bodies of water. Concerning the fact that poor sanitation is linked to transmission of diseases such as cholera, diarrhoea, dysentery, hepatitis A, typhoid and polio, WHO has mentioned of a possibility of major parasitic & water-borne epidemics in Africa, where only 7% of the regional population had used a safely managed sanitation service. The report also issued that 842000 people in LICs and MICs (Middle-Income

Countries, where GDP per capita is 1025 ~ 12475 USD) die as a result of inadequate water, sanitation, and hygiene each year, representing 58% of total diarrhoeal deaths. Poor sanitation is believed to be the main cause in some 280000 of these deaths.

Moreover, at least 10% of the world's population is thought to consume food irrigated by wastewater, which might have promoted major parasitization.

Water-Induced Conflicts and Consequences 1: Grand Ethiopian Renaissance Dam (GERD)

GERD is a dam located on Ethiopia, near its border with Sudan. When the construction is completed, the size of the dam will be 170m tall and 1.8km wide. The artificial reservoir created by the dam is expected to be able to store 74 million liters of water, generating 6000MW of electricity maximum.

Egypt views the building of the GERD as a threat to its national security. The Nile provides nearly all of Egypt's water. Egypt claims 2/3 of that flow based on a treaty with Sudan, signed in 1959. However, this is no longer enough to satisfy the growing population (1.8% growth in 2015) and agricultural sector. Annual water supply per person has fallen by over half since 1970.

There is uncertainty over the dam's ultimate use. Ethiopia insists that it will produce only power and that the water pushing its turbines (less storage time, thus less evaporations while the water stays in the reservoir) will ultimately flow downstream. Egyptians, however, fear it will also be used for irrigation, reducing downstream water supply.

Another concern is over the dam's large reservoir. If filled too quickly, it would for a time significantly reduce Egypt's water supply and affect the electricity-generating capacity and irrigation capacity of its own Aswan Dam. But the Ethiopian government faces pressure to see a quick return on its investment. The project, which is mostly self-funded, will cost around $4.8 billion. Some experts say filling the reservoir could take seven years.

Egypt has tended to use military threats in Nile disputes but is unlikely to be able to follow the threat through. This has soured relations with the other countries that share the Nile River Basin. UN has already warned of a looming crisis due to these complex political situations over the water-resource.

Water-Induced Conflicts and Consequences 2: Euphrates River

Euphrates River is a river originating from eastern provinces of Turkey, flowing through the Syria, eventually to the Gulf.
After World War I, as former Ottoman Empire was partitioned, Treaty of Lausanne stipulated that the three riparian states of the Euphrates had to reach a mutual agreement on the use of its water and on the construction of any hydraulic installation.

An agreement between Turkey and Iraq signed in 1946 required Turkey to report to Iraq on any hydraulic changes it made on the Tigris–Euphrates river system, and allowed Iraq to construct dams on Turkish territory to manage the flow of the Euphrates.

Then in 1975, the Keban Dam of Turkey and Tabqa Dam of Syria was constructed and reservoirs were filled. At the same time, the area was hit by severe

drought and river flow toward Iraq was reduced from 15300 billion liters (in 1973) to 9400 billion liters (in 1975) within less than two years. This led to an international crisis during which Iraq threatened to bomb the Tabqa Dam. An agreement was eventually reached between Syria and Iraq after intervention by Saudi Arabia and the Soviet Union.

A similar crisis, although not escalating to the point of military threats, occurred in 1981 when the Keban Dam reservoir had to be refilled after it had been almost emptied to temporarily increase Turkey's hydroelectricity production. In 1987, Turkey and Syria, signed a new bilateral treaty that Turkey would ensure a flow of at least 500000 liters per second, or 16000 billion liters per year, into Syria. These conditions were once again further expanded by another bilateral agreement, in 1989 between Syria and Iraq, settling the amount of water flowing into Iraq at 60 percent of the amount that Syria receives from Turkey.

In 2008, Turkey, Syria and Iraq instigated the Joint Trilateral Committee (JTC) on the management of the water in the Tigris–Euphrates basin and on 3 September 2009 a further agreement was signed to this effect.

On April 15, 2014, Turkey began to reduce the flow of the Euphrates into Syria and Iraq. The flow was cut off completely on May 16, 2014 resulting in the Euphrates terminating at the Turkish–Syrian border. This was in violation of an agreement reached in 1987.

Major Countries and Organizations Involved

United Nations World Water Assessment Programme (UN WWAP)

This key UN-Water report is an annual review providing an authoritative picture of the state, use and management of the world’s freshwater resources. In addition to coordinating this significant UN report, UN WWAP monitors freshwater issues in order to provide recommendations, develop case studies, enhance assessment capacity at a national level and inform the decision-making process. UN WWAP seeks to equip water managers and key decision-makers with the information, data, tools and skills necessary to enable them to effectively participate in the development of policies.

World Water Council

An international think tank found in 1996. It’s dedicated to promoting awareness, build political commitment and trigger action on critical water issues at all levels, since it was initially established.

Every third year the World Water Council organizes the World Water Forum in close collaboration with the authorities of the hosting country. The Forum is the largest international event in the field of water.

International Union for Conservation of Nature and Natural Resources (IUCN)

The world economic forum has an initiative of “Influence, encourage and assist societies throughout the world to conserve nature and to ensure that any use of natural resources is equitable and ecologically sustainable”. It works in the field of sustainable use of natural resources, and believes that the water-resource is at the center of achieving sustainable development.

Timeline of Events & Relevant UN Treaties and Events

The following table includes the timeline of relevant international events, including attempts to solve the issue, UN resolutions and treaties.

Date	Relevant International Events and Descriptions
Mar. 1977	**Mar del Plata UN Water Conference** **First United Nations Water Conference.** The Action Plan from the United Nations Water Conference recognized water as a right for the first time.
Nov. 1989	**Convention on the Rights of the Child** The **Article 24(2**) explicitly mentions water, environmental sanitation and hygiene.
Jan. 1992	**International Conference on Water and Sustainable Development. Dublin Conference** **Principle 4** of the Dublin Conference states that "… it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price".
Jun. 1992	**United Nations Conference on Environment and Development. Rio Summit** **Chapter 18 of Agenda 21** endorsed the Resolution of the Mar del Plata Water Conference that all peoples have the right to have access to drinking water, and called this "the commonly agreed premise."
Sep. 1994	**United Nations International Conference on Population and Development** The **Programme of Action of the UN International Conference on Population and Development** affirms that all individuals: "Have the right to … water and sanitation."
Dec. 1999	**UN General Assembly Resolution A/Res/54/175 "The Right to Development"** **Article 12** of the Resolution affirms that the rights to food and clean water are fundamental human rights and their promotion constitutes a moral imperative both for national Governments and for the international community.
Nov. 2002	**General Comment No. 15. The right to water** **General Comment 15** interprets the 1966 International Covenant on Economic, Social and Cultural Rights (ICESCR) confirming the right to water in international law. This Comment provides guidelines for the interpretation of the right to water, framing it within two articles, **Article 11**, the right to an adequate standard of living, and **Article 12**, the right to the highest attainable standard of health. The Comment clearly outlines States parties obligations to the right and defines what actions would constitute as a violation. **Article I.1** states that "The human right to water is indispensable for leading a life in human dignity. It is a prerequisite for the realization of other human rights".
Mar. 2005	At the Johannesburg World Summit for Sustainable Development, in 2002, one of the

~ Dec. 2015	Sustainable Development target was to include basic sanitation, and water was recognized as a critical factor for meeting all the Goals. Since Johannesburg, further international deliberations on water and sanitation had helped advance cooperation and action in this area. Significant progress had been made since then in providing people with access to clean drinking water and basic sanitation. But a major effort was still required to extend these essential services to those of them still unserved, the vast majority of who were poor people. Given the magnitude of the task, in December 2003, **the United Nations General Assembly, in resolution A/RES/58/217, proclaimed the period 2005-2015 International Decade for Action 'Water for Life'.** The decade officially started on World Water Day, March 22, 2005. During this period, The primary goal of the 'Water for Life' Decade was to promote efforts to fulfill international commitments made on water and water-related issues by 2015. Focus had been on furthering cooperation at all levels, so that the water-related goals of the Millennium Declaration, the Johannesburg Plan of Implementation of the World Summit for Sustainable Development, and Agenda 21 can be achieved in the near future. The challenge of the Decade was **to focus attention on action-oriented activities and policies that ensure the long-term sustainable management of water resources**, in terms of both quantity and quality, and **included measures to improve sanitation**.
July. 2005	**Draft Guidelines for the Realization of the Right to Drinking Water and Sanitation. E/CN.4/Sub.2/2005/25** These draft guidelines, contained in **the report of the Special Rapporteur to the UN Economic and Social Council, El Hadji Guissé**, and adopted in Sub-Commission on the Promotion and Protection of Human Rights, are intended to assist government policymakers, international agencies and members of civil society working in the water and sanitation sector to implement the right to potable water and sanitation. These Guidelines do NOT legally define the right to water and sanitation, but rather provide guidance for its implementation.
Nov. 2006	**Human Rights Council Decision 2/104** The Human Rights Council "Request the Office of the United Nations High Commissioner for Human Rights, taking into account the views of States and other stakeholders, to conduct, within existing resources, a detailed study on the scope and content of the relevant human rights obligations related to equitable access to safe drinking water and sanitation under international human rights instruments, which includes relevant conclusions and recommendations thereon, to be submitted prior to the sixth session of the Council".
Aug. 2007	**Report of the United Nations High Commissioner for Human Rights** on the scope and content of the relevant human rights obligations related to equitable access to safe drinking water and sanitation under international human rights instruments Following **decision 2/104 of the Human Rights Council**, **the Report from the High Commissioner for Human Rights** states that "It is now the time to consider access to

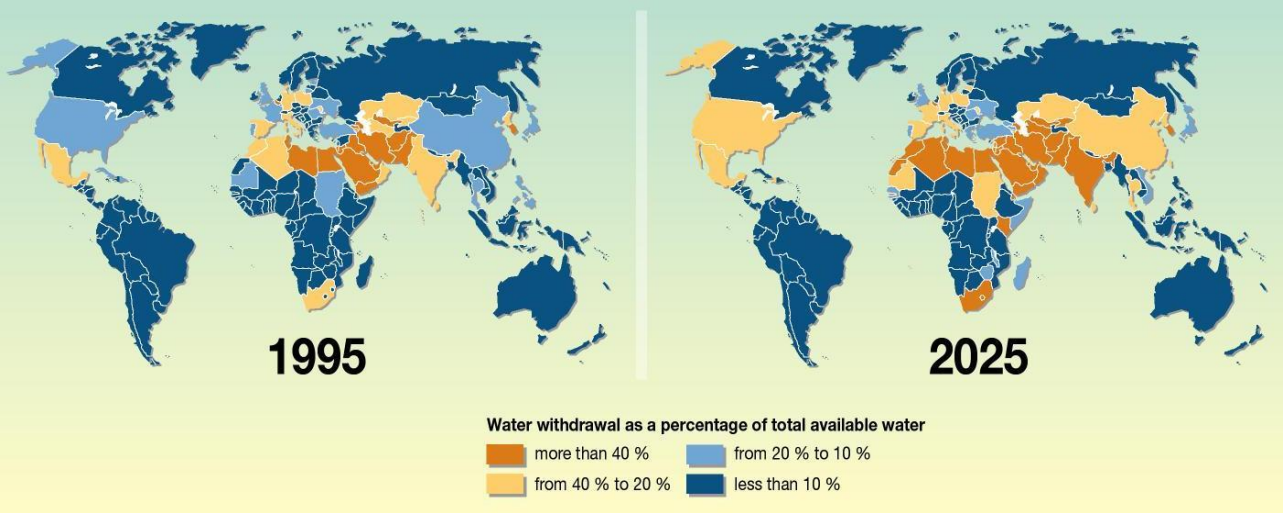
	safe drinking water and sanitation as a human right, defined as the right to equal and nondiscriminatory access to a sufficient amount of safe drinking water for personal and domestic uses… to sustain life and health".
Mar. 2008	**Human Rights Council Resolution 7/22** Through this resolution, the Human Rights Council decides "To appoint, for a period of three years, an independent expert on the issue of human rights obligations related to access to safe drinking water and sanitation".
Oct. 2009	**Human Rights Council Resolution 12/8** In this resolution, the Human Rights Council welcomes the consultation with the independent expert on the issue of human rights obligations related to access to safe drinking water and sanitation, acknowledges the independent expert's first annual report and, for the first time, recognizes that States have an obligation to address and eliminate discrimination with regard to access to sanitation, and urges them to address effectively inequalities in this area.
Jul. 2010	**UN General Assembly Resolution A/RES/64/292** **For the first time, this UN Resolution formally recognizes for the right to water and sanitation and acknowledges that clean drinking water and sanitation are essential to the realization of all human rights.** The Resolution calls upon States and international organizations to provide financial resources, help capacity-building and technology transfer to help countries, in particular developing countries, to provide safe, clean, accessible and affordable drinking water and sanitation for all.
Sep. 2010	**Human Rights Council Resolution A/HRC/RES/15/9** Following the UN General Assembly resolution, this resolution of the UN Human Rights Council affirms that the rights to water and sanitation are part of existing international law and confirms that these rights are legally binding upon States. It also calls upon States to develop appropriate tools and mechanisms to achieve progressively the full realization of human rights obligations related to access to safe drinking water and sanitation, including in currently unserved and underserved areas.
Apr. 2011	**Human Rights Council Resolution A/HRC/RES/16/2** In this resolution, the Human Rights Council decides "to extend the mandate of the current mandate holder as a special rapporteur on the human right to safe drinking water and sanitation for a period of three years" and "Encourages the Special Rapporteur, in fulfilling his or her mandate… to promote the full realization of the human right to safe drinking water and sanitation by, inter alia, continuing to give particular emphasis to practical solutions with regard to its implementation, in particular in the context of country missions, and following the criteria of availability, quality, physical accessibility, affordability and acceptability".

Previous Attempts to solve the Issue

Future scenarios: WWAP 2014

The recent report of <World Water Assessment Programme> was published by United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2014.

The report explicitly recognized the significance of water as a core concept of sustainable development, hence discussed various possibilities of future earth hydrosphere, its correlation to the changes on ecosystem, and eventually its effects on the socio-economic conditions of human society, with the precise object of alarming the people by providing suggestions of the future world.



Scenario 1 – Conventional World

This scenario of the report suggest the possibility that no further efforts to preserve the water-resource security were given by the global society, thus the status quo is maintained. Like any other reports published by ecological NGOs, it's predicted that, initially, the ecosystem of LICs (Low-Income Countries) mainly located on Africa and West-Asia will be destructed. This then causes a slight economic depression at the regional level, eventually leading the world to a long-term economic depression.

Scenario 2 – Conflict World

The second scenario was initially mentioned by World Bank in early 2000. It mentions of the possibility of a total-war, escalated from the frequent minor-conflicts induced due to the water-resources disputes. The report warned of a new cold-war period or World War III, most likely to be provoked by or broken out among the countries through which major international rivers flow.

Scenario 3 – Techno-World

Next scenario is a bit unique, compared to others, as it takes an assumption that the speed of advancement of science & technology will be accelerated exponentially, and soon the popularization of above-stated technologies, such as seawater desalination, will be there in the near future.

The benefits of these new technologies, however, are unlikely to be introduced to those who most need, LICs, without delay due to the high initial investment cost. Moreover, the newly-introduced technology in the HICs (High-Income Countries) might reduce the industrial production cost of a range of products, resulting in zero-sum global water availability due to the increased resource consumption.

Scenario 4 – Global Consciousness

Unlike any other scenarios present on the report, this scenario is expecting that there would be a rapid change on the social ideology among the HICs. For a short period of time, there would be no

change on the attitude of each country. However, a few minor climate disasters soon encourages the governments to agree on a big-deal on the environmental preservation and sustainable development plan. The new diplomatic cooperative system significantly reduces the total greenhouse gas emissions; at the same time it encourages the investments on new innovative ecological industrial technologies.

Scenario 5 – Conventional World gone Sour

Last but not least, the report also presented an alarming scenario for the world. Initially, the environmental condition worsens at the same rate as the Scenario 1, showing a gradual degradation, such as constant desertification, decrease in annual precipitation. However, in a near-future, the rate of environmental degradation progress gets exponentially accelerated, causing a major shortage on essential water in the most of the countries (this includes HICs) and collapse of the conventional social system. Eventually, the mankind loses the majority of their scientific progress, and forced to go back into the pre-industrial era.

Possible Solutions

Overcoming Water Scarcity 1: Water Purification Filter and Pills

Majority of the impurities present in the contaminated water can be treated to be suitable for drinking. These impurities may include chemicals, suspended solids, biological contaminants and gases. According to United States Department of Defense, government supplies for soldiers include a simple filtering kit, which includes sand (physical filtering – removes macro-impurities) and purification pills (chemical filtering – a.k.a. Aquatabs – often made of NaClO – removes biological & chemical impurities). This method allows a temporary purification of contaminated water, but does not guarantee purification ability, nor is usable in case there's absolutely no water available.

Overcoming Water Scarcity 2: Rainwater harvesting

Water harvesting refers to making use of available water before it drains away or evaporates. Efficiency of rainwater harvesting can be improved in many ways, for example:

- irrigation of individual plants rather than whole fields
- covering expanses of water with plastic or chemicals to reduce evaporation
- storage of water underground in gravel-filled reservoirs (again to reduce evaporation losses).

Rainwater harvesting aims to capture and channel a greater share of rainfall into the soil, and conserve moisture in the root zone where crops can use it. Harvested rainwater can either be channeled directly to a field, stored in a tank or small reservoir for later use, or allowed to percolate through the soil to recharge the groundwater. Some of the large-scale rainwater reservoirs are built entirely from local debris, significantly decreasing the budget required.

Overcoming Water Scarcity 3: Groundwater Development

This method is not much of 21st century creative scientific innovative method, but still can be useful in some regions, Great Artesian Basin of Australia for instance. UN is currently supporting a groundwater development project for some Sub-Saharan countries of Africa. Details of the project include installation of bicycle-shaped pump, simple filtering device for long-term use (approx. 2~3years), and so on.

In case the depth of water table is rather deep, however, the cost for developing groundwater might be burdensome, or it might even be impossible to develop. Furthermore, due to its characteristics of groundwater, the amount of minerals might be excessive in a few cases, disallowing the utilization of groundwater as a drinking water.

Overcoming Water Scarcity 4: Artificial Precipitation

The process inducing or increasing the amount of precipitation with the help of chemical catalysts is known as Artificial Precipitation. It's also more commonly known as Rainmaking.

It's a widely known commonsense that the formation of cloud is so crucial for precipitation, and that cloud is a dense block of water vapors surrounding a small condensation nucleus. In the atmosphere, water vapors are always present, but the condensation nuclei are not. Hence, either an airplane or a weather rocket artificially provides the condensation nuclei such as dry ice, Silver Iodide – AgI, and Calcium Chloride – $CaCl_2$.

Recently, China is putting an outstanding amount of effort on both experimental and operational artificial precipitation. According to Chinese Research Academy of Environmental Sciences, average cost of a rocket including Calcium Chloride stored inside is about 300 USD. Their "Operational Objective" is various, from removal of microdusts to prevention of further inland desertification. Yet, there are a constant number of international and internal atmospheric researches concerning the correlation of artificial precipitation and abnormal weather phenomena.

Overcoming Water Scarcity 5: Iceberg Utilization

Although it's a very experimental approach to the water-resource security issues, a group of geoengineers in United States examined the economic and environmental effectiveness of utilizing iceberg as a water source. Computer simulation results are hopeful, estimated population of 550000 is expected to get supplied enough water from the iceberg of 200m length, width, and height for the domestic use for one year. The problem is, remember, this is very experimental for the time being.

Overcoming Water Scarcity 6: Smart Water Grid

Back in 2017, Republic of Korea Government, Ministry of Science and ICT, introduced the water grid and pipelines management system of next generation. The new system has introduced three major ICT-related features.

Intelligent Metering Infrastructure allows the supplier to be able to check consumers' water metering device, automatically sending an alarm to WAMAC in case major waterleak is suspected in a particular building.

Sensor-Integrated Pipeline includes a new surrounding layer of various engineering sensors to the pipelines, such as a hydrometer, a calorimeter (for steam pipes), a flowmeter, and a pipe-connection checker. These sensors automatically reports to WAMAC in every 1/60 seconds, enabling the real-time monitoring of water demand, water supply, and leaking on the pipelines.

WAMAC is originally the core part of electricity grid management system. It receives the automatic reports from the entire water pipeline system in every 1/60 seconds, and manipulates various management factors, the rate at which water intaking device is operated for example, to minimize the oversupply and waste of water-resources. It also notifies pipeline failures to the management team, regulating the water loss at its minimum level.

Smart Grid technology give a great In 2016, according to the statistics, United States was able to conserve 4921 billion liters of water, 2000GWh of electricity, and reduce greenhouse effect gas emission by 14 giga tons. This proves that the new management system could be very successfully utilized to save a lot of water-resources and energies without facing any further NIMBY resistance, as there are no further expansions of 'ugly' facilities. This, however, is only applicable to the region with the modern sanitation system already installed.

Overcoming Water Scarcity 7: Seawater Desalination

Among the total water present on the earth, the ratio of seawater is about 97.5%. Moreover, about half of the global population live within 500km from the coast. With the help of technological advancement, desalination, a process taking away mineral components from saline water, appeared to modern countries as a considerable option to overcome potable water scarcity.

In 2017, 19121 desalination plants operated worldwide, produced 89800(L/Day, average), provided water for over 300 million people, according to International Desalination Association.

Desalination is mostly favored by dry or steppe countries, such as Australia and oil-producing Middle-East countries. For example, in case of Kuwait, 99% of the nation's water was supplied through the desalination process in 2018.

There are two popular desalination methods.

One is Distillation Desalination Method, which is derived into various sub-categories nowadays. Basically, saline water is heated to generate steam, which is to be re-condensed in a separated cooler.

Distillation Desalination Method requires a lot of energy to boil the water. However, the purity of water is relatively higher than any other desalination method, as its mechanism is similar to that of distilled water production, and can easily constructed. This method is favored among Oil-Rich Middle-East countries, which have capabilities to continuously and cheaply supply enormous amount of energy in forms of fossil fuels.

Figure 1: Principle of Osmosis

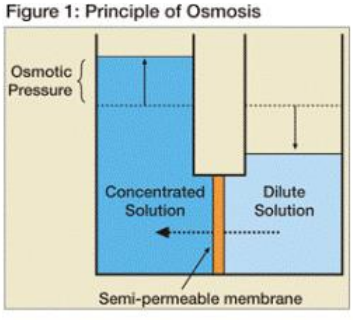
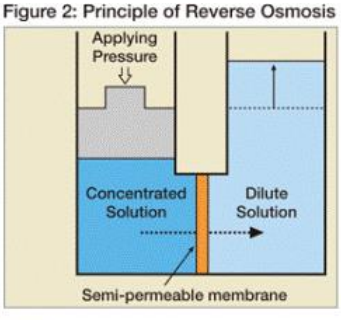
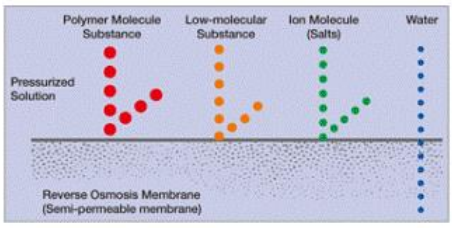


Figure 2: Principle of Reverse Osmosis





The other is Reverse Osmosis Desalination Method, often known as RO. Figures above show the basic concept of RO Desalination process. Semipermeable membrane only allows water particles to penetrate. Under natural osmosis conditions, the water particles move from lower-concentration side to higher-concentration side (Fig1). Hence, pressure should be artificially applied on the higher-concentration side in order to collect water particles on the lower-concentration side, unlike naturally occurring osmosis (Fig2).

Since only half the energy required for Distillation Desalination is needed for RO process, desalination plant located on most of the countries are under this category. In contrast to Distillation Desalination, the purity of desalinated water is relatively low. Also, the maintenance cost is higher.

Desalination is not only common as a major water source of dry and steppe countries, but also present as a secured emergency water source. Singapore, relying heavily on imported water-resource, has projected further establishment of desalination plants, to protect the nation's water-resource security.

Like any other matters, desalination also has its own benefits and costs. Although the desalination seems to be very effective, as it basically allows people to utilize rest 97.5% of water present on the earth, establishments and maintenances of desalination plants require a large amount of finance and elite technicians graduated higher education, making it highly difficult for LICs to count on desalination. Also, there's a high possibility that desalination plant might be destructed or neutralized in times of war and natural disaster.

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